Jeongbhin Seo, Ph.D.

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Employment History

2024.10 - - · · · · **Chick Keller Fellow,** Los Alamos National Laboratory, Theoretical Division
Advisor: Dr. Fan Guo, Dr. Hui Li

2023.12 - - 2024.9 **Postdoctoral Researcher,** Los Alamos National Laboratory, Theoretical Division
Advisor: Dr. Fan Guo, Dr. Hui Li

2022.9 - - 2023.11 **Postdoctoral Researcher,** Department of Physics, Ulsan National Institute of Science & Technology.
Advisor: Prof. Dongsu Ryu

Education

2018.09 - - 2022.08 **Ph.D., Pusan National University** Earth Science.
Advisor: Prof. Hyesung Kang
Degree date: 08/26/2022
Thesis title: *A Simulation Study of Ultra-relativistic Jets.*

2015.03 - - 2018.02 **M.Sc., Pusan National University** Earth Science.
Advisor: Prof. Hyesung Kang
Degree date: 02/23/2018
Thesis title: *The Contribution of Stellar Winds to Cosmic Ray Production.*

2008.03 - - 2012.02 **B.Ed., Pusan National University** Earth Science Education.
Degree date: 02/17/2012

Awards and Fellowships

2024 **LANL SPOT Award**, Los Alamos National Laboratory

2024-2027 **Chick Keller Fellow**, Los Alamos National Laboratory

2021 **Busan Future Scientist Award** , Federation of Busan Science and Technology

2020-2022 **NRF Ph.D. Fellow**, The National Research Foundation of Korea

Research Publications

First-Author Papers

1. **J. Seo**, F. Guo, X. Li, B. Chen, C. Shen, and H. Li, "Energetic nonthermal electrons within the above-the-looptop regions in solar flares: Acceleration, feedback, and quasiperiodic pulsations," *The Astrophysical Journal*, vol. 997, no. 2, p. 313, Jan. 2026. DOI: 10.3847/1538-4357/ae2de6.

2. **J. Seo**, D. Ryu, and H. Kang, "Energy spectrum and mass composition of ultra-high-energy cosmic rays originating from relativistic jets of nearby radio galaxies," *The Astrophysical Journal*, vol. 988, no. 2, p. 194, Jul. 2025. DOI: 10.3847/1538-4357/ade678.

3. **J. Seo**, F. Guo, X. Li, and H. Li, "Proton acceleration in low-β magnetic reconnection with energetic particle feedback," *The Astrophysical Journal*, vol. 977, no. 2, p. 146, Dec. 2024. DOI: 10.3847/1538-4357/ad8e64.

4. **J. Seo**, H. Kang, and D. Ryu, "Model spectrum of ultrahigh-energy cosmic rays accelerated in fr-i radio galaxy jets," *The Astrophysical Journal*, vol. 962, no. 1, p. 46, Feb. 2024. DOI: 10.3847/1538-4357/ad182c.

5. **J. Seo**, H. Kang, and D. Ryu, "A new code for relativistic hydrodynamics and its application to fr ii radio jets," *IAU Symposium*, vol. 362, pp. 87–93, Jan. 2023. DOI: 10.1017/S1743921322001314.

6. **J. Seo** and D. Ryu, "How-mhd: A high-order weno-based magnetohydrodynamic code with a high-order constrained transport algorithm for astrophysical applications," *Astrophysical Journal*, vol. 953, no. 1, 39, p. 39, Aug. 2023. DOI: 10.3847/1538-4357/acdf4b.

7. **J. Seo**, D. Ryu, and H. Kang, "A simulation study of ultra-relativistic jets. iii. particle acceleration in fr-ii jets," *Astrophysical Journal*, vol. 944, no. 2, 199, p. 199, Feb. 2023. DOI: 10.3847/1538-4357/acb3ba.

8. **J. Seo**, H. Kang, and D. Ryu, "A simulation study of ultra-relativistic jets. ii. structures and dynamics of fr-ii jets," *Astrophysical Journal*, vol. 920, no. 2, 144, p. 144, Oct. 2021. DOI: 10.3847/1538-4357/ac19b4.

9. **J. Seo**, H. Kang, D. Ryu, S. Ha, and I. Chattopadhyay, "A simulation study of ultra-relativistic jets-i. a new code for relativistic hydrodynamics," *Astrophysical Journal*, vol. 920, no. 2, 143, p. 143, Oct. 2021. DOI: 10.3847/1538-4357/ac19b3.

10. **J. Seo**, H. Kang, and D. Ryu, "The contribution of stellar winds to cosmic ray production," *Journal of Korean Astronomical Society*, vol. 51, no. 2, pp. 37–48, Apr. 2018. DOI: 10.5303/JKAS.2018.51.2.37.

Co-Authored Papers

1. F. Guo, O. French, Q. Zhang, X. Li, and **J. Seo**, "Particle injection problem in magnetic reconnection and turbulence," *Space Science Reviews*, vol. 221, no. 103, 2025. DOI: 10.1007/s11214-025-01226-x.

2. H. Kang, D. Ryu, and **J. Seo**, "Simulation Study of Binary Mergers of Galaxy Clusters I: Properties of Merger Shocks and Radio Emission," *arXiv e-prints*, arXiv:2512.07214, arXiv:2512.07214, Dec. 2025. arXiv: 2512.07214 [astro-ph.HE].

3. X. Li, C. Shen, X. Xie, F. Guo, B. Chen, I. Oparin, Y. Wei, S. Yu, and **J. Seo**, "Energy conversion and electron acceleration and transport in 3d simulations of solar flares," *The Astrophysical Journal*, vol. 991, no. 2, p. 202, Sep. 2025. DOI: 10.3847/1538-4357/adfcd5.

4. A. Bhattacharjee, **J. Seo**, D. Ryu, and H. Kang, "A simulation study of low-power relativistic jets: Flow dynamics and radio morphology of fr-i jets," *The Astrophysical Journal*, vol. 976, no. 1, p. 91, Nov. 2024. DOI: 10.3847/1538-4357/ad83cc.

Code Development

HOW-HD	High-order hydrodynamic code with WENO reconstruction
HOW-RHD	High-order relativistic hydrodynamic code with fully relativistic EOS, WENO reconstruction, and Strong Stability Preserving Runge–Kutta (SSPRK)
HOW-MHD	High-order magnetohydrodynamic code with WENO reconstruction, SSPRK, and high-order finite-difference constrained transport (CT) algorithm
MHD-SDE	MHD framework coupled with Parker's Transport Equation solved using stochastic differential equations (SDEs), including self-consistent feedback from energetic particles
MHD-CRe	Finite-difference Fokker–Planck solver with WENO reconstruction and Strong Stability Preserving Runge–Kutta implicit–explicit (SSP-IMEX) time integration

High Performance Computing

5M CPU Times	LANL HPC, MHD, Particle acceleration simulations

High Performance Computing (continued)

3M CPU Times	NERSC, MHD, Particle acceleration simulations
1M GPU Times	NERSC, VPIC-hybrid Simulations
4M CPU Times	CHEA Cluster, MHD, RHD, Monte-Carlo simulations
2M CPU Times	UNIST Supercomputing Center, RHD simulations
1M CPU Times	PNU Cluster, HD, RHD, Monte-Carlo simulations

Skills

Languages	English, Korean
Programming	Fortran, Python, C++, IDL, LaTeX, OpenMP, MPI
Research Areas	Particle acceleration, Magnetic reconnection, Collisionless shocks, Relativistic jets, Solar flares, Heliosphere, Galaxy clusters, Astrophysical turbulence
Techniques	Hydrodynamics (HD), Relativistic hydrodynamics (RHD), Magnetohydrodynamics (MHD), Monte Carlo simulations, Numerical modeling, high-order methods, and large-scale simulation code development

Collaboration

2023 - - · · · · **IBEX/IMAP Team**
Los Alamos National Laboratory

EOVSA Solar Flare Group
NJIT, Harvard-CfA

2022 - - · · · · **Wombat User Group**
University of Minnesota

2019 - - · · · · **Center for High Energy Astrophysics (CHEA)**
Ulsan National Institute of Science & Technology, South Korea

Conferences

Invited Talks, Seminars, and Colloquia

2025.07 "A New Computational Method for Energetic Particle Acceleration and Transport with Feedback: Applications to Magnetic Reconnection and Turbulence."
Midwest Magnetic Fields Workshop 2025, Madison, WI.

2025.04 "Efficient Acceleration and Feedback of Non-Thermal Electrons in Solar Flares."
HSR Team+ Workshop 2025: Energy Release and Conversion in Solar Eruptive Events, NJIT, Newark, NJ.

2024.10 "A New Code for Relativistic Hydrodynamics and Its Application."
Geophysical and Astrophysical Fluid Dynamics (GAFD) Seminar Series, UC Santa Cruz, Santa Cruz, CA.

2024.04 "Acceleration of Non-Thermal Electrons in Solar Flares."
CfA Solar Science Meeting, Harvard–Smithsonian Center for Astrophysics, Cambridge, MA.

Conferences (continued)

- "Radio Galaxy Jets as the Origin of Ultra-High-Energy Cosmic Rays."
  CfA High Energy Seminar, Harvard–Smithsonian Center for Astrophysics, Cambridge, MA.
- "Radio Galaxy Jets as the Origin of Ultra-High-Energy Cosmic Rays."
  CfA Galaxy Cluster Group Meeting, Harvard–Smithsonian Center for Astrophysics, Cambridge, MA.

2024.03 "Particle Acceleration in Astrophysical Phenomena."
LANL Plasma Group Seminar, Los Alamos National Laboratory, Los Alamos, NM.

2023.11 "Radio Galaxies as the Origin of Ultra-High-Energy Cosmic Rays."
71st GWNR Workshop, Daejeon, South Korea.

2023.03 "Acceleration of Ultra-High-Energy Cosmic Rays at Radio Galaxy Jets."
The VLBI Group Seminar, Max-Planck Institute, (Online), Germany.

2023.01 "A Simulation Study of Radio Galaxy Jets."
2023 SKA-Korea Workshop, Cheonan, South Korea.

2022.09 "Introduction to Relativistic Hydrodynamics Simulations and Their Applications."
66th GWNR Workshop, Pohang, South Korea.

2021.12 "FR-II Radio Jets and the Acceleration of UHECRs."
Korea Young Astronomers Meeting Colloquium, (Online), South Korea.

International Conferences

2025.12 "A New Global Heliosphere Model with Pickup Ion and ENA Production and Transport."
AGU Fall Meeting 2024, New Orleans, LA, Poster.

"Energetic Particle Acceleration in Magnetic Reconnection: Feedback and Plasma Beta Dependence."
AGU Fall Meeting 2024, New Orleans, LA, Poster.

2025.06 "Efficient Acceleration and Feedback of Non-Thermal Electrons in Solar Flares."
SHINE Workshop, Charleston, SC, Poster.

2024.12 "Acceleration and Transport of Nonthermal Electrons in the Solar Flare Region."
AGU Fall Meeting 2024, Washington, DC, Poster.

"Particle Acceleration in Magnetic Reconnection with Feedback from Energetic Particles."
AGU Fall Meeting 2024, Washington, DC, Talk.

2024.08 "Efficient Electron Acceleration in the Solar Flare Region."
SHINE Workshop, Juneau, AK, Poster.

2024.07 "Acceleration of Non-Thermal Electrons in Solar Flares."
HINODE-17/IRIS-15/SPHERE-3 Joint Meeting, Bozeman, MT, Talk.

2023.07 "Generation of Ultra-High-Energy Cosmic Rays at Radio Galaxy Jets."
ICGAC15, Gyeongju, South Korea, Talk.

2023.06 "A New WENO Magnetohydrodynamic Code with a High-Order Constrained Transport Scheme."
2023 ASTRONUM, Pasadena, CA, Poster.

2022.09 "Particle Acceleration at Relativistic Jets of FR-II Radio Galaxies."
2022 IAUGA, Busan, South Korea, Poster.

2022.06 "Relativistic Hydrodynamic Simulations of Ultra-Relativistic Jets in the Intracluster Medium."
2022 EAS, Valencia, Spain, Poster.

2021.11 "A New Code for Relativistic Hydrodynamics and Its Application to FR-II Radio Jets."
IAU Symposium 362: Computational Astrophysics, (Online), Talk.

Conferences (continued)

Domestic Conferences

2023.10 "Radio Galaxies as the Origin of Ultra-High-Energy Cosmic Rays."
2023 108th KAS Fall Meeting, Jeju, South Korea, Talk.

2023.04 "A New Magnetohydrodynamic Code with a High-Order Constrained Transport Scheme."
2023 107th KAS Spring Meeting, Jeonju, South Korea, Talk.

2022.12 "Particle Acceleration in Radio Galaxy Jets."
6th CHEA Workshop, Cheonan, South Korea.

2022.04 "Acceleration of Ultra-High-Energy Cosmic Rays at Relativistic Jets."
2022 105th KAS Spring Meeting, Busan, South Korea, Talk.

2021.11 "FR-II Radio Jets and the Acceleration of UHECRs."
5th CHEA Workshop, Busan, South Korea.

2021.10 "FR-II Radio Jets and the Acceleration of UHECRs."
2021 104th KAS Fall Meeting, Jeju, South Korea, Talk.

2021.04 "Structures and Energetics of Flows in Ultra-Relativistic Jets."
2021 103rd KAS Spring Meeting, (Online), South Korea, Talk.

2020.10 "A New Code for Relativistic Hydrodynamics."
2020 102nd KAS Fall Meeting, (Online), South Korea, Poster.

"Morphology and Dynamical Properties of Ultra-Relativistic Jets."
2020 102nd KAS Fall Meeting, (Online), South Korea, Talk.

2020.01 "A Simulation Study of Ultra-Relativistic Jets."
4th CHEA Workshop, Busan, South Korea.

2019.01 "The Contribution of Stellar Winds to Cosmic Ray Production."
3rd CHEA Workshop, Gyeongju, South Korea.

Public Outreach

2023.08 "Astronomical Observation: Theory and Practice."
Physics Festival for High School Students, Ulsan, South Korea.

2023.07 "Relativistic Hydrodynamics and Simulating Ultra-Relativistic Jets."
Numerical Relativity and Gravitational Wave Summer School, Daejeon, South Korea.

2023.05 "Becoming an Astrophysicist: Career Pathways."
Gaeun Middle School, Yangsan, South Korea.

"Becoming an Astrophysicist: Career Pathways."
Muryong High School, Ulsan, South Korea.

2023.01 "Numerical Methods for Solving Partial Differential Equations."
Numerical Relativity and Gravitational Wave Winter School, Ulsan, South Korea.

2022.11 "From Science Teacher to Astrophysicist."
PNU Future Education Center, Busan, South Korea.

2022.10 "Inside the Work of an Astrophysicist."
Gaeun Middle School, Yangsan, South Korea.

2022.07 "Career Mentoring: Exploring Astrophysics."
PNU Future Education Center, Busan, South Korea.

2021.12 "How Coding Powers Astrophysics."
Mulgeum High School, Yangsan, South Korea.

Public Outreach (continued)

2021.11 "Inside the Work of an Astrophysicist."
Muryong High School, Ulsan, South Korea.

Academic services

2024.10 - - · · · · **Journal Reviewer**
Astrophysical Journal

2024.02 - - · · · · **Workshop Organizer**
LANL Plasma Group Meeting

2023.03 - - 2024.04 **Workshop Organizer**
68th-72nd Workshop on Gravitational Waves and Numerical Relativity

2023.05 - - 2023.11 **Workshop Organizer**
2023 Korea Numerical Astrophysics Group Workshop

Teaching Experience

2024.02 - - · · · · **Undergraduate & Postbac Mentor**
Los Alamos National Laboratory (LANL), NM, United States

- Supervised three student researchers (Purdue University, UC Santa Cruz, University of Utah) through the LANL internship program on topics of magnetic reconnection, relativistic hydrodynamics, and heliospheric modeling.
- Organized weekly intern workshops to enhance presentation and scientific communication skills.

2020.03 - - 2022.08 **Teaching Assistant**
Pusan National University, South Korea

2012.03 - - 2019.08 **High/Middle School Science Teacher**
Gyeongsangnam-do Office of Education, South Korea